MODERN TESTS OF KIDNEY FUNCTION

It is difficult to believe that prior to 1912 there was no adequate clinical test available to determine the status of kidney function. The world owes a great debt to Rowntree and Geraghty, therefore, for the phthalein test. This method still is very satisfactory, and serves the purpose for the physician and the hospital where laboratory equipment and facilities are limited, where quick results are desired, or when a check-up of other tests of renal function becomes necessary.

The phthalein test is carried out as follows: About one hour before the test the patient is given from 400 to 600 cubic centimeters of water. One cubic centimeter of a specially prepared solution, containing six milligrams of phenolsulphonephthalein, is injected either intravenously or intramuscularly, preferably in the lumbar muscles. At the end of one hour (in case of intravenous injection) or two hours and ten minutes (two hours for excretion and ten minutes for the absorption of the drug in case of intramuscular injection), the urine is collected. It is made basic with 10 cubic centimeters of 15 per cent sodium hydroxid, diluted to one liter, and the percentage of phthalein excreted is determined by comparison with the standard, in a suitable colorimeter (*e. g.*, colorimeter Duboscq or the Dunning colorimeter).

The normal excretion of phthalein is from 40 to 60 per cent for the first hour, and from 20 to 30 per cent for the second hour (the same figures hold true for the first and second half-hours in case of the intravenous injection), although in many instances the lower normal limit (total) appears to be 50 per cent. In children the usual output is 10 per cent higher. Also the time of appearance of the dye in the urine is noteworthy. In normal function of the kidney it is from four to five minutes, following the intravenous injection.

Attempts to give the phthalein elimination a special significance, as an index of either tubular or glomerular activity, have not been entirely successful. With the study of the excretion of such substances as water, urea, and salt (which are the natural products of metabolism and are continuously eliminated by the kidney, and whose excessive elimination or retention can now be more and more definitely interpreted in terms of renal disturbances), the phthalein test has been superseded.

Studies of renal excretory products furnish a basis for deductions that lead to a more rational therapy, and to greater advances in clinical medicine than a test with a more or less mechanical interpretation can do. The phthalein test is of particular value to the physician who has not specialized in the diseases of the urinary tract and who wants to know, in numerical terms, to what degree the kidney is functioning satisfactorily.

Modern tests for renal function that deal with the normal excretory products of the kidneys can be divided into two groups: one of these is of recent development (by Addis and Van Slyke) and constitutes a method by which the total amount of functioning tissue in the kidneys may be determined; the other group of tests aims at determining whether the kidneys, under customary conditions of diet, activity, etc., are capable of maintaining the blood and tissues free from the accumulation of urinary excretory products.

The amount of functioning renal tissue may be determined by the "blood urea clearance" of Van Slyke, which promises to be one of the most important tests for kidney function at our command, as it is now recognized that the usual test for renal function may indicate impairment only when 50 to 60 per cent of the renal tissue has been put out of commission, while the Van Slyke test detects functional impairment when the first half or less of the kidney substance is rendered inactive (or lost).

The necessary data for determining the blood urea clearance, as a measure of renal efficiency, C, are as follows: (1) the concentration of urea in the blood, B; (2) the concentration of urea in the urine, U; and (3) the volume of urine in cubic centimeters excreted in one minute, V. This test is expressed by the formula: $C = \frac{U}{B}\sqrt{V}$ The excretion rate observed with the average normal blood urea clearance is what would be obtained, if 75 cubic centimeters of blood per minute passed the kidneys, and all its urea were excreted.

Decrease in the volume of blood cleared of urea per minute in pathologic conditions must be due to one of two causes: either the volume of blood per minute passing through the kidneys is diminished, or the proportion of its urea removed during the passage is less than normal.

The tests which determine the ability of the kidney to prevent the accumulation of urinary excretory products within the body give an answer to the question of how well the remaining renal tissue can cope with the dietary and metabolic burden imposed upon it.

The blood chemistry has contributed a great deal to the better understanding of Bright's disease. The fact that albuminuria, increased arterial pressure, and even certain forms of uremia, often occur without an accumulation of urinary excretory products within the body, made it clear that "nephritis" is not solely (nor even predominantly) characterized by diminished kidney function. Urea nitrogen, creatinin, and uric acid are considered most important substances in the blood to be studied for testing the kidney function: as renal insufficiency develops, a successive retention of urea, uric acid, and, finally, creatinin within the blood takes place. The blood urea nitrogen has been, and still is, the substance most generally tested. Its direct estimation, as well as its relation to the urea in the urine, as Ambard's constant, as the blood urea clearance test of Van Slyke's, etc., has proved to be very valuable, being very sensitive in detecting the earliest signs of kidney disease and having a definite diagnostic significance. Clearance values above 75 per cent

of normal usually suggest no impairment of renal function. Values between 75 and 50 per cent should be considered in the doubtful range. Below 50 per cent of normal always implies decreased renal efficiency.

Ambard found out that elimination of at least certain substances is carried on by the kidneys, according to definite laws which are capable of mathematical expression, by a formula known as Ambard's coefficient or constant: $K=\frac{Ur}{\sqrt{D}\times\frac{70}{wt.}\times\sqrt{c/25}}$

where *Ur* is grams of urea per liter of blood, *D* is grams of urea excreted in twenty-four hours, *wt.* is weight of patient in kilograms, *C* is grams of urea per liter of urine. The normal value of the Ambard coefficient is between 0.07 and 0.09. In impaired function with an ability of the kidney to eliminate in proportion to the concentration of urea in the blood, there is a rise in the coefficient in proportion of the degree of renal insufficiency. Values of 0.09 to 0.12 indicate slight impairment; 0.13 to 0.2, a moderate degree of impairment; and above 0.20, severe renal impairment.

1025 Story Building.

S. I. Movitt,
Los Angeles.

LOCAL INJECTION OF PROCAIN: IN THE DIAGNOSIS AND TREATMENT OF DERANGEMENTS OF CERTAIN JOINTS

Pain is one of our most significant criteria in diagnosis. It follows that the temporary elimination of such pain by the local injection of procain has great possibilities in differentiating various disturbances of joints.

The occurrence of painful inflammatory changes, with or without calcification, in the subdeltoid bursa is often accompanied by the sudden loss of the power to initiate abduction of the shoulder, due to a reflex inhibition of the supraspinatus muscle. When the onset of symptoms is associated with injury, the diagnosis of rupture of the supraspinatus tendon is suggested. Because such a rupture, if complete, demands early surgical repair, it is imperative to distinguish actual breaks in the continuity of this tendon, from inflammatory changes in the same region. The injection of 10 to 15 cubic centimeters of one per cent procain hydrochlorid into this bursa [1,2] will eliminate the pain and reflex supraspinatus inhibition caused by any inflammation of the bursa, and will permit immediate active abduction of the shoulder through its normal range. This active painless exercise of the shoulder overcomes adhesions in the bursa and frequently affords permanent relief from symptoms. In other cases the injection of procain into the bicipital groove, with the disappearance of pain, which formerly occurred on certain movements of the shoulder and elbow, may confirm the suspected diagnosis of inflammation or "slipping" of the tendon of the long head of the biceps. Marked improvement or cure was obtained following the injection of procain into the bicipital groove in three out of four patients whose symptoms were localized to this region. Schulhof [3] has relieved "painful shoulders" by the slow injection of 30 to 50 cubic centimeters of warm one-half per cent solution of procain into the subdeltoid bursa.

Coste [4] prefers to inject the supraspinous and circumflex nerves with procain in the treatment of peri-articular arthritis of the shoulder. Following anatomic studies, which showed the richness of articular ligaments in sensory-nerve endings, Leriche [5] advocated the infiltration of these ligaments with procain in functional post-traumatic articular disturbances after sprains or fractures. The anesthesia of the joints thus produced also permits their mobilization following arthroplasties or arthrotomies.

The injection of 25 cubic centimeters of one per cent procain into the region of the sacro-iliac joint, following the oral administration of three grains of sodium amytal, can be used to differentiate a sprain or arthritis of this joint from similar involvement of the lumbosacral joint, and from pure sciatic neuritis. A needle three inches long is inserted at a point over the midline of the sacrum, at the level of the two posterior superior iliac spines, and is directed laterally at an angle of forty-five degrees with the skin. By such an insertion the point of the needle passes between the lateral portion of the sacrum and the overhanging posterior superior iliac spine, and reaches the posterior margin of the sacro-iliac joint. The posterior sacro-iliac ligaments are infiltrated with procain, some of which may reach the sacro-iliac joint. Following the injection it is usually possible to manipulate the sacro-iliac joint quite freely by straight leg flexion of the hip. In addition to the relief obtained from such manipulation, some benefit probably results from the distention and stretching of the sacro-iliac ligaments due to the injection of the solution.

Doubtless many other applications of the principle of the injection of procain for diagnosis and treatment will suggest themselves.

350 Post Street.

Keene O. Haldeman,
San Francisco.

1 Soto-Hall, R., and Haldeman, K. O.: Muscle and Tendon Injuries—In the Shoulder Region, Calif. and West. Med., 41:318-321 (Nov.), 1934.

2 Haldeman, K. O., and Soto-Hall, R.: Injuries to Muscles and Tendons, J. A. M. A., 104:2319-2324 (June 29), 1935.

3 Schulhof, E.: Die Subdeltoidale Injection zur Behandlung der Periarthritis Humeroscapularis, Zentralbl. f. Chir., 53:1364-1366, 1926.

4 Coste, M. F.: Sur les Infiltrations Anesthésiques Periarticulaires, Bull. et mem. soc. med. d. hôp. de Paris, 49:627-630, 1933.

5 Leriche, R.: Des Effets de L'anesthésie a la Novocaine des Ligaments et des Insertions Tendineuses Periarticulaires dans Certaines Maladies Articulaires et dans les Vices de Position Fonctionnels des Articulations, Gaz. d. hôp., 73:1294 (Sept. 10), 1930.

The joy of creation is so exalted that it has been called divine. Next to it is the joy of coming to know what has been wrought and thought by the most highly endowed members of the race. Through them and their achievements we discern powers and qualities latent within ourselves. The more we understand, the more we appreciate and the richer life becomes.—Leon J. Richardson.